

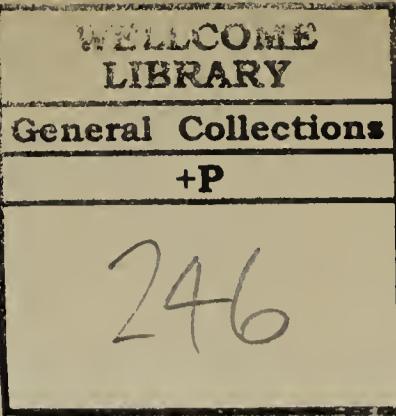


REPORT
ON THE
OUTBREAK OF TYPHOID FEVER
DURING THE
AUTUMN OF 1890,
IN THE
SOUTHEND URBAN SANITARY DISTRICT,
BY
JOHN C. THRESH, D. Sc. (Lond.), M.B., B. Ch. (Vic.)

*Fellow of the Institute of Chemistry, Fellow of the Chemical Society,
Fellow of the Royal Meteorological Society, etc., etc., Medical Officer
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Member of Council of the Society of Medical Officers of Health.*



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TO THE CHAIRMAN AND MEMBERS OF THE SANITARY COMMITTEE OF THE
SOUTHEND LOCAL BOARD.

GENTLEMEN,

I have the honour of presenting to you my Report on the cause of the Typhoid epidemic which has recently prevailed in Southend, and also of submitting to you a series of recommendations for preventing the occurrence of such outbreaks in future. The Report has been somewhat delayed on account of the extreme care which had to be taken in the analysis of the numerous samples of water, and in the examination of the whole of the waterworks system. This was necessitated by the fact that the sewerage systems and water mains cover almost exactly the same areas. With probably half-a-dozen exceptions, every house in your district which is connected with the sewers is also supplied with water from the Company's mains, and *vice versa*.

I have little to add to my Report, but I desire here to emphasise what has been said with reference to what are usually considered minor sanitary defects. Your district, on account of its position, and also because it is such a popular Health Resort, is especially liable to small outbreaks of Typhoid fever, either arising sporadically, or from cases imported from without. Defects, therefore, which elsewhere would perhaps be of little moment, become of considerable importance, and accordingly should receive much more careful attention than they have done heretofore.

No allusion has been made in the body of the Report to the cases of fever which have occurred amongst visitors who, remaining in Southend a short time, returned home to develop the disease. Particulars of such cases have been sent me by medical men and others, but as I found their histories threw no additional light on the cause of the outbreak, I decided not to complicate my Report by any reference thereto.

Another omission from the Report may be commented upon, if not explained, and that is, the absence of any reference to the intercepting sewer which I understand you propose having laid, and which will relieve considerably the Pier Outfall. This sewer, in my opinion, will only be a partial remedy for the defects pointed out in my Report; it will not prevent the periodical flooding of the lower parts of the town, and the objectionable sewer outfalls on the beach will remain as before. For these reasons I cannot express my approval of the scheme, and recommend that a competent sewer engineer be consulted with reference to the whole of the defects in your sewerage systems, so as to devise once for all a remedy for those conditions whose continued existence is a standing menace to the health and prosperity of the town.

I desire to express here my thanks to your Committee for the facilities offered in order to make the investigation as thorough as possible. Your Clerk, Surveyor, and Inspector have rendered me invaluable assistance. The Waterworks Company allowed me to examine everything in connection with their works, and to inspect their books and registers, and my especial thanks are due to them and to their courteous and energetic manager, Mr. Bilham. The latter gentleman kindly carried out for me a series of experiments to demonstrate how readily, in small inadequately ventilated drains and sewers, sewer air could be forced through traps, and how readily traps could be unsealed. As the results were of more than local interest, they will probably ultimately be published. My thanks are also due to your Medical Officer of Health, for much important information and assistance; to the Medical Men of the town and surrounding districts, for the promptitude with which they have answered all my enquiries; and to other gentlemen, who from time to time have aided me in the investigation.

I have the honour to be, Gentlemen,

Your obedient Servant,

JOHN C. THRESH.

CHELMSFORD,

November 21, 1890.

Dr. Thresh's Report to the Local Board on the extensive prevalence of
Typhoid Fever in Southend, Essex.

The Urban Sanitary District of Southend has an area of about 3400 acres, and comprises three distinct populous districts—Southend proper, Prittlewell, and Porters Town. It is situated near the mouth of the Thames on its Northern bank. The town of Southend lies on the river's edge, Prittlewell is about one mile inland, whilst Porters Town is between the two and a little to the East.

The Eastern and older portion of the town is built on ground only a few feet above Ordnance datum ; behind the ground rises gently towards Porters Town, and on this slope new streets of houses are being rapidly built. The Western division of the Town is more modern, and occupies an almost level tract of land on the Cliffs, having an elevation of about 100 feet above Ordnance datum. The Cliffs slope somewhat abruptly to the river's bank. Most of Prittlewell lies on the Northern boundary of this area, one portion, North Street, being on ground sloping to the North.

The population of Southend at the last census was 7947, with an average of 5.3 persons to a house. The number of inhabited houses is now stated to be 2280, and taking the same average to still obtain, the population will be 12,116. During the season (July to October) there are large numbers of visitors staying in the town. It is very difficult to get a reliable estimate, some asserting that there are as many as 20,000 during the height of the season ; if we take half that number as the average we have a population of 22,000 during the summer months. Besides these, crowds of day excursionists are brought in daily, a moderate estimate being 2000 per day.

Geologically considered Southend is built upon a patch of brick earth and sand lying upon the London clay. This patch is of very unequal thickness, thinning off both towards the East and West, and thickest therefore in the middle, where it seems to fill in a valley in the clay, having a maximum depth of about 45 feet. Porters Town lies upon this thicker portion of the sand, in which the ground water level seems to be from 20 to 25 feet from the surface.

Southend being a popular seaside resort, contains no manufactories in which any considerable number of work people congregate. There is however an extensive brick yard between the town and Prittlewell, and a considerable amount of refuse matter (contents of ashbins etc.) is brought in barges from London and burnt at the brick-kilns, causing a decided nuisance when the wind blows from the North, *i.e.*, from the kilns towards the town.

A large proportion of the houses are small villas, usually in terraces of from 6 to 12. I have no reason to consider that they are structurally more defective than similar houses in other watering places. Mr. SHIRLEY MURPHY describes them fairly in his report dated March, 1888, and as I shall have to deal somewhat fully with certain defects at a later period, there is no necessity to go into further details now.

M At present, Southend has no Hospital for Infectious diseases, therefore, such cases are not isolated. Neither does the Town possess any apparatus for disinfecting infected bedding, clothing, etc.

All the houses are now furnished with water closets, none of which are flushed directly from the water mains. A large proportion are hand flushed, the others have small cisterns supplying the closets only. *250 out of 2000*

With the exception of about 120 houses lying towards the outskirts of the Urban S. District, all are supplied with water from the wells of the Southend Waterworks Company, and derived from the chalk underlying the London Clay, Oldhaven, Woolwich, and Thanet beds, which here have a thickness of about 600 feet. There are three wells—the Southend well, at the West end of the town, sunk in 1864, when the Cliff-town Estate was being laid out; the Prittlewell well, sunk in 1880; and the Eastwood well, sunk last year.

The Southend well is 906 feet deep, 385 feet being sunk and lined with brickwork, and 521 feet bored. The surface soil here was only three feet in thickness, and was cleared off when the well was made. Below this is 30 feet of stiff yellow clay, and 384 feet of blue clay. The boring extends 304 feet into the chalk. When not pumping the water will rise to within 200 feet of the surface, but by pumping it can be reduced to 267 feet.

The Prittlewell well is sunk 360 feet and bored 517 feet. The section is as under: sand and gravel 46 feet, London clay 362 feet, sand 119 feet, chalk 350 feet. The sunk portion is lined with brick, an immense iron cylinder being inserted at the junction of the sand and London clay. When not pumping the water rises to within 220 feet of the surface, by pumping it can be reduced to 294 feet.

The Eastwood well is 685 feet deep, 247 feet being sunk, and 438 feet bored. The section is as follows:—surface soil, 5 feet, sand, brick earth and gravel, 43 feet, London clay, 228 feet, sand, etc., 151 feet, chalk, 258 feet. The sunk portion is lined in the same manner as the Prittlewell well. Water rises to within 96 feet of the surface, but by close pumping is reduced to 130 feet. This well is only 50 feet above Ordnance datum, whilst Prittlewell is $101\frac{1}{2}$ feet, and Southend 108 feet above that line.

The water from the Eastwood well is pumped into a rising main which passes by the pumping station at Prittlewell, where it is joined by the main from this well, it is then continued to the Southend Station, where the main from this is connected. It then proceeds to the water tower near, entering at the bottom, and when the tank is full the water overflows into a large brick-lined reservoir in the same enclosure. The tower overflow is 159.4 feet above Ordnance datum, the reservoir overflow $117\frac{1}{2}$ feet. The bottom of the reservoir is about on the level with the roadway.

The trunk main from Eastwood gives off branches for the supply of Prittlewell. After receiving the Prittlewell water, branch mains supply Porters Town, London Road, Milton Road, the Roads branching off to the West and Avenue Terrace, and part of

Avenue Road. After receiving the Southend water, the trunk main gives off branches to Cliftonville Terrace, and Trinity and Marine Avenues before entering the tank. From the tank all the higher portion of Southend is supplied, that is the portion bounded by London Road, High Street, The Cliffs and Milton Road. The reservoir supplies all the Town to the East of High Street. A portion of Southchurch lying on the beach is also supplied with water from the reservoir.

From this brief description of the waterworks it will be seen that when the pumps at Eastwood are in action, Prittlewell is being supplied with water from that source, and from that source only unless the demand at Prittlewell exceeds the pumping power, when water would flow from the Prittlewell station to meet the extra demand. In the same way the districts supplied by branch mains between the Prittlewell and Southend stations will be supplied by a mixture of Eastwood and Prittlewell waters, or by a mixture of all three waters, if the demand be greater than the two wells can supply. The districts supplied from the tank and reservoir will always receive a mixture in varying proportions of water from all three sources

A coloured map is appended showing the districts supplied (a) by Eastwood water chiefly, (b) by Eastwood and Prittlewell waters chiefly, and (c) by a mixture of all three waters.

The supply is constant, there has been no intermission during the year, and the pressure in the mains is always considerably more than sufficient to supply the most elevated house in Southend. At the Company's Offices in the centre of the town the lowest pressure is at 6 a.m., and varies from 43 to 48 feet. On Marine Parade the average pressure is 102 feet.

*Map V
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The Sewerage Systems. Until 24 years ago many single houses and terraces had separate drains and sewers emptying on to the beach. The houses further from the shore had cesspools, but with a few exceptions these were filled in when the town was sewered. When Cliff Town was built upon in 1860, brick sewers with earthenware inverters were laid down, with an outfall in the Swatch. In 1867 a sewer was laid for Scott's Villas, a terrace of about 50 houses. Since then it has been relaid. It consists of 15-inch pipes. The outfall sewer is laid on the beach, and terminates about 75 yards from the land. It has a flap valve at its extremity. The Marine Parade east sewer was laid in 1870, and the outfall, a 15-inch iron pipe, runs alongside the Scott's Villas sewer, and terminates about 125 yards from the shore. Its extremity is also protected by a flap valve. The pier outfall system was laid in 1870, and the Cliff Town sewers connected therewith. Porters Town was sewered about 14 years ago and is now connected with the Prittlewell Sewer. The Prittlewell sewer was constructed in 1881, and joins the pier outfall at the end of Grove Road. The outfall is an iron pipe, 15 inches in diameter, terminating in the Leigh Swatch, 4000 feet from the shore. When the Hamlet Valley district was first being built upon, the builders drained the houses into a ditch. In 1879-80 however the Local Board constructed the Hamlet Valley sewer and outfall, and most of the sewers there were laid by the Board. The outfall, an iron pipe of 12 inches diameter, terminates in the Leigh Swatch, about 2900 feet from the shore.

A map of the sewerage system is appended, showing by different coloured shadings the districts connected with the various sewers.

The surveyor informs me that altogether there are over 15 miles of sewers, made up as under:—

	Miles	Yards	Miles	Yards
			5	157
9 in. stoneware pipes				
12 „ „ „	5	877}	6	84
12 „ Iron „		967}		
15 „ Stoneware „	2	17		1683
15 „ Iron „		1666}		
18 „ Stoneware „				690
24 „ „ „				83
Brick Culverts (Cliff Town)				1446
			Total 15	623

With about a dozen exceptions the unconnected houses are in outlying portions of the district.

The 37 houses drained into the Prittlewell tank lie to the North, on ground sloping away from Southend. They could not therefore be connected with any of the pre-existing sewers.

Further details of the sewerage system will have to be considered later, but I may here give a table provided for me by Mr. Dodd and Mr. Whur.

DISTRICT.	No. of Houses.	Number of Ventilating Shafts.	Number of open sewer Ventilators	Number of closed ditto.
Pier Outfall	1322	46	43	111
Hamlet Valley	350	14	13	18
Marine Parade	382	14	24	25
Scott's Villas	50	3	0	5
North Street Tank	37	1		
Houses not connected with any of these outfalls	143			

The only arrangements for flushing are on the Prittlewell sewer, which has but little fall. There are three tanks, one of 1800, one of 1200, and the third of 360 gallons capacity, and with these the sewer is flushed twice a week. I have recently been informed that there is a flushing tank at the summit of the two Marine Parade sewers. All the other sewers are considered sufficiently self-cleansing not to require flushing.

*us having
in Courts*
Public Scavenging. The Local Board undertakes the removal of house refuse, etc., collecting some parts of the districts once a week, other parts once in three

weeks. Many complaints were made to me of the offensive odours from the accumulations of shells about the yards and premises of the numerous oyster and fish shops in the hot weather. There is no doubt matter of this kind should be removed from the premises much more frequently in summer. A medical man has written me saying the carts used to 'stink fearfully' as they went from house to house.

Southend Mortality Statistics. In a report published by me in the beginning of the present year I showed that the Rochford Registration district of Essex, whilst having a comparatively low death rate, not only from all causes, but from the Zymotic diseases taken as a whole, yet had a death rate from Typhoid fever far higher than that of any other division in the County. I now find that the Typhoid rate in Southend slightly exceeds that of the whole of the Rochford district of which it forms a part. The mortality statistics for Southend for the 5 years 1885-89 are given below.

YEAR.	Small-pox.	Measles.	Scarlet fever	Diphtheria.	Croup.	Whooping Cough.	Fever.	Diarrhoea.	Deaths from all Zymotic diseases.	TOTAL DEATHS.
1885	1	1	3		6	6	2	8	27	178
1886			2	3	2	4	6	11	28	152
1887					2		5	12	19	153
1888			2	2	2	2	3	2	13	169
1889			7			8	5	6	26	191
	1	1	14	5	12	20	21	39	113	843

SOUTHEND. ESSEX.

Mean Zymotic Death rate for five years 1885-89	2.0	2.4
„ Typhoid „ „	.38	.185
„ Diarrhoea „ „	.70	.61
„ Death rate from all causes	15.	17.4

prevalent

This table shows that Typhoid fever is more than twice as fatal in Southend than in Essex as a whole. It is important to bear in mind this predilection of Typhoid fever* for Southend, whilst attempting to trace the cause of the recent epidemic.

In a table given later on, all the known cases of Typhoid fever which have occurred in Southend since the beginning of 1885 are tabulated, so as to show the numbers which have occurred in certain districts into which I have divided the town. I shall have especially to draw attention to the fact that in certain areas Typhoid has prevailed every season for years past, and the epidemic of last year will have to be referred to somewhat in detail, in order to throw light on the cause of the present outbreak.

* Typhoid fever is much more prevalent along the Northern banks of the Thames than elsewhere in Essex. Probably the County Council may at some future date recognise that it is its duty to have the cause thoroughly investigated. Is the London Sewage responsible for this condition? or the primitive method of sewage disposal so generally adopted?

Subjoined is a diagrammatic representation of the number of cases of Typhoid fever reported each month since June, 1888. It will be noted that in September, 1888, nine attacks occurred, then there was an interval of seven months, during which the town was free from fever. In May and June, 1889, four cases were reported, two in each month, five occurred in July, 13 in August, 14 in September, 13 in October, 10 in November, and only one in December. In January of the present year there were three cases, in February and March no cases, in April and May two cases each, none in June, four in July, and 12 in August. So far the course of the fever this year closely resembles that of last year, but in September, instead of the number of cases remaining stationary as in 1889, there was a sudden increase, 60 cases having been notified, and in October there was a still further though small increase, 69 cases having come under treatment. Altogether this year up to the end of October 156 cases were notified, occurring in 125 houses. Although the outbreak did not occur with that explosive violence usually characterising epidemics due to polluted water or milk, still reference to the next table will show that there was a somewhat sudden increase in the week ending September 4th, since which period the weekly number of cases has continued high.

Typhoid cases notified during the epidemic.

CASES.			CASES.	
Week ending, August 7	0		Week ending, October 2	12
„ „ 14	6		„ „ 9	17
„ „ 21	3		„ „ 16	15
„ „ 28	4		„ „ 23	22
„ September 4	14		„ „ 30	8
„ „ 11	15		„ November 6	15
„ „ 18	17			
„ „ 25	7			

Of the 156 cases which occurred from the first of January to the end of October, the age and sex has been ascertained in 152.

AGE AND SEX DISTRIBUTION.

	Under 1 yr	1—5 yrs.	5—15 yrs.	15—25 yrs	25—35 yrs	35—45 yrs	over 45 yrs	Totals.
Males ...	1	9	28	21	13	7	6	85
Females ...	0	1	14	19	12	14	7	67
Totals ...	1	10	42	40	25	21	13	152

From this table we learn that 55 per cent. of the persons attacked were males, and that 65 per cent. of the patients were over 15 years of age. The importance of these figures will be seen later on.

The cases were distributed in the 125 houses as under —

18 houses with 2 cases in each	...	...	36 cases
1 house „ 3 „ „	...	...	3 „
1 „ „ 12 „ „	...	...	12 „
105 „ „ 1 „ „	...	...	105 „
<hr/>			<hr/>
Total 125			Total 156
<hr/>			<hr/>

The large number of houses invaded in proportion to the number of persons attacked will also at a subsequent stage be found to have an important bearing upon the subject under investigation.

Of the seven cases which occurred prior to July, 4 were in houses on the Marine Parade sewer, viz:—2 in Strutts Cottages, 1 in Pleasant Road, and 1 in Albert Road. The two latter were undoubtedly contracted in the same house, the sufferers being related and having lived together until a few days before they were attacked. In this same house a fatal case of Typhoid had occurred in December last, and so far as I can gather, no adequate precautions had been taken to prevent the recurrence of the disease. The 5th case occurred at the Victoria Hospital, the 6th at the Royal Mews, and the 7th in Alexandra Road. These houses are all upon the Pier Outfall Sewer. Of the 4 cases which occurred in July, 2 were undoubtedly imported, the third was probably due to drainage defects, the drain being blocked when the case was notified. The cause in the 4th case is not so clear. One of the imported cases occurred in Princes Street: the patient was ill upon arriving in Southend on July 9th, and went straight to bed. A week later Typhoid symptoms were pronounced. The second case was imported into Norfolk Street on July 18th, the patient being ill on arrival. A medical man was called in the same day, and found him to be suffering from Typhoid fever. The case above mentioned as being probably due to drainage defects occurred in Porters Town, whilst the fourth case was in Francis Terrace. As this latter is on the Hamlet Valley Sewer, it is important to note that *at the end of July there were cases of fever on all the three principal systems of sewers.*

The seventeen cases notified during August exhibited the same scattered arrangement, but it is interesting to note that up to the end of this month no case had occurred in Prittlewell. Only one of the August cases can with certainty be put down as imported, and this into an already infected area, Grosvenor Place on the Marine Parade sewer. The first case which occurred in Prittlewell was that of a labourer employed in Southend. He appears to have been about until the last week in August, when he took to his bed, and died on September 3rd. A second case (father of the first) occurred in the same house, and was notified on the 11th; it was doubtless contracted from the son. Four other cases occurred in Prittlewell during the month, two of people working in Southend, the third that of a woman who had been nursing a Typhoid patient, and the fourth occurred in an unhealthy house in Bragg's Yard. Only one case has been reported since in Prittlewell.

Sixty cases were notified during September, and 68 in October.

All parts of the town of Southend therefore seem to have been affected from the first, whilst Prittlewell was only affected for a few weeks in August and September.

Before proceeding to trace out the cause of the epidemic it may be as well to draw attention to one or two points in connection with the outbreak. In the epidemic of last year no less than 12 cases occurred in the 50 houses on the Scott's Villa Sewer, this year no case has been notified from any one of these houses.* One case only has occurred in the 37 houses on the Prittlewell tank sewer, and the connection which existed between the W. C. and the kitchen sink may have been the cause, though as this sewer had not been specifically infected, I think it much more probable that the disease was contracted in Southend, where the patient was employed.

Another matter of much importance in connection with the investigation, is the prevalence of Typhoid during the present autumn in the districts around Southend. My inquiries prove conclusively that there has been an unusual amount of Typhoid at Leigh, Shoebury, Southchurch, Rochford and other places. The extent to which it has prevailed may be gathered from the following table compiled from information very kindly furnished me by the medical gentlemen practising in the districts named.

DISTRICT.	Estimated population.	Number of cases to end of October.	Number per thousand of population.
Leigh	1760	19	10.8
South Shoebury (not including Garrison)	1400	20	14.3
Southchurch	600	9	15.0
Southend	12000	134	11.1

It will be observed that, excluding visitors from our estimate of the Southend population, and also the cases which occurred amongst visitors, the proportion of cases which has occurred in Southend during the present Autumn, is considerably less than that which has obtained in two contiguous parishes, and about the same as in a third.

Cause of the Epidemic. There are two ways by which the specific poison of Typhoid fever may enter the system. 1.—By introduction into the alimentary canal by means of some article of food or drink, generally water or milk. 2.—By introduction into the respiratory organs during the inhalation of specifically infected sewer air, or the emanations from Typhoid stools.

The former mode shall be considered first: In consequence of Mr. Shirley Murphy's report on the minor outbreaks of 1886 and 1887, causing suspicion to rest upon the milk supply as a cause of one, at least, of these, I found on first visiting Southend early in October that there was considerable uneasiness expressed as to whether the milk was not the means by which the disease was being spread. A large number of people were changing milkmen, the result however being that the customers lost by a milk dealer in one district, were made up for by new ones obtained in another.

This changing about made it somewhat more difficult to ascertain accurately the names of the milkmen supplying the houses prior to the occurrence of the fever. I however

* Since writing this Report cases of Typhoid have appeared in Scott's Villas.

obtained reliable information in most of the cases, and the results prove that the milk has had nothing to do with the outbreak. The houses in which 69 of the earliest recorded cases occurred were supplied by 18 different milk purveyors, the highest numbers from any one dealer being 8 in one case and 7 in another. These dealers were very large if not the two largest purveyors. A further inquiry as to the source of the milk supplied by the various milkmen, merely confirmed the conclusion that the milk was not the cause of the epidemic.

The probability of the disease being disseminated by means of some beverage, other than milk or water, has also been considered. The enquiries instituted to ascertain if such were the case failed even to excite a suspicion of anything of the kind.

The suggestion that the Typhoid was originally due to the eating of pork from pigs affected with swine fever, must be dismissed as in the highest degree improbable. Typhoid fever has never so far as I am aware been traced to such a cause, and it would be a difficult matter to prove that such flesh had ever been imported into the town.

The part played by the 'Native' oyster in spreading the disease is very uncertain. The oyster boxes moored on the beach must from time to time be bathed in sewage polluted water, and during the present autumn the sewage has been specifically polluted. It is not impossible therefore that these bivalves may in rare instances have caused infection. No such case however can be proved, but during my investigations I have discovered at least a dozen instances in which nausea, diarrhoea, etc., have resulted from eating oysters purchased in the town. It is a well-known fact that certain other shell fish are laid out on the fore-shore near two of the sewer outfalls, and when fattened are again collected and sent to London, and that Typhoid fever should be disseminated through their agency is by no means impossible.

Water Supply.

The most common cause of Typhoid outbreaks, a polluted water supply, must next be considered. Although the epidemic of this year commenced exactly as the one in the previous year, and also occurred in each case at that season when Typhoid is most prevalent throughout the whole country, yet its onset in so many different portions of the Town at or about the same time, rendered it absolutely necessary that the possibility of the water supply being contaminated, should be rigorously investigated. To this end I collected samples of water at various places and at various times, and submitted them to a most careful analysis. The results I have also compared with the analyses of the water made at earlier dates by well known Analysts and Medical Officers, and also with analyses of other waters from the same strata which I have recently had to examine, and which were undoubtedly free from pollution. Such of the analytical data as I shall have briefly to refer to again are given in an Appendix to this report.

Three samples were taken by myself on October 11th. (1) from a cottage in Prittlewell, (2) from a cottage in Newlands Road, and (3) from a house in Cambridge Terrace. Chemical analysis furnished no evidence of pollution, and the microscopic examination of the minute quantity of deposit obtained after long standing, revealed only a little calcareous matter and oxide of iron; there was no trace of vegetable or animal life.

On October 15th samples of water were taken direct from the rising mains at each of the pumping stations. Chemical analysis and microscopical examination again failed to find any signs of pollution. The only constituent which was at all variable was the Free Ammonia, but a discussion as to the cause would be out of place in this report. It must suffice for me to state that in itself it is no indication of any organic impurity in the water.

On November 2nd another sample was taken from the main at the Southend pumping station, and a sample from a house in Alexandra Street. On November 7th three samples were taken, (1) from No. 6, Railway Place, (2) from the Sunflower Coffee Tavern and (3) from No. 40, Park Street, all infected houses. All these samples were exceedingly free from organic impurity.

Finally, on November 13th, after the engines had been at rest for 11 hours, and when the water had reached its highest level in the Southend well, a workman was lowered into the well, and collected according to instructions samples of water from the surface. The engines were then set in motion, and when it was judged that all the water which had stood in the main had been removed, samples were taken from it. These I examined most carefully side by side, and the differences found upon analysis gave not the slightest indications of any contamination.

Although neither the microscope nor chemical analysis may detect impurity, there is still the possibility of the specific poison of Typhoid being present, in minute quantity certainly, but still sufficient to cause an outbreak of fever. Many such cases are well known. After analysing the first batch of waters, therefore, I carefully examined everything in connection with the wells, the pumping stations, the tank and reservoir; the Waterworks Company, through their Manager, giving me every possible assistance in my investigations. The wells were uncovered, and at Eastwood the sides were illuminated so that I could see beyond the iron cylinder at the junction of the sand and clay, not a particle of moisture was to be seen. At Prittlewell I descended about 60 feet by aid of the ladders, and found the sides perfectly dry. At Southend the sides of the well were observed to be moist, but this was explained by the fact that there is a pressure valve on the head of the vertical main, and from time to time water is ejected with considerable violence and trickles down the sides. At a later period I was lowered by rope and windlass some 70 feet down the well and carefully examined the sides. They were uniformly moist, and here and there were slight calcareous incrustations on the surface of the bricks, but I could discover no signs of any fluid oozing from without into the well. The deposit before mentioned seemed to have been formed by the water ejected from the valve dissolving a little lime from the cement in the upper portion of the well, and depositing it by evaporation as it descended. The position, depth, etc. of the nearest sewers were also ascertained, but nothing was discovered indicating even the possibility of the contamination of the deep well water.

As previously stated Prittlewell district is now chiefly supplied by water from the Eastwood well (area coloured blue in map), whilst Porters Town and the remainder of the area coloured red is supplied chiefly from the mixed waters of the Prittlewell and Eastwood wells. The remainder of Southend receives a mixture of all three waters, the higher portion of the town, coloured yellow, being supplied from the tank, and the lower, coloured green, from the reservoir.

Counting the houses in each area, and also the number of infected houses, we obtain the following percentage.

DISTRICT.	No. of Houses.	No. of Houses invaded.	Per Cent.
Chiefly supplied by Eastwood water	228	6	2·6
,, Eastwood & Prittlewell water	593	35	6·0
Supplied by mixture of all three waters	1319	84	6·4
All district	2140	125	5·9

This table seems conclusively to clear the Eastwood water from suspicion. Water from this well was first pumped into the mains on June 9th of this year, yet the general outbreak did not occur until two months later, and the district which during part of July, all August and September, was being supplied day and night by this water, was the last to be affected, and has suffered least.

The district supplied by the Eastwood and Prittlewell waters suffered more severely, but the proportion of houses attacked here is smaller than in the remaining portion of Southend. Had the Prittlewell water been the cause, then the district supplied chiefly from that station should have shown an excessive proportion of houses attacked, but this is not the case.

In Southend proper, supplied by a mixture of water from all three wells, up to October 31st, the date to which all the above figures refer, 6·4 per cent. of the houses had been invaded; this is only slightly in excess of that which obtained over the area last considered. During the past season I find that water was pumped to supply the whole district in the following proportions from the various wells:—

Prittlewell	44·
Southend	36·
Eastwood	20·

The amount of Prittlewell water pumped day by day was much more than sufficient to supply the district mains given off between that and the Southend pumping station, therefore it could only be during the night, when the pumps at Prittlewell were not working, that any Southend water could flow back into that district. In the High Street, there is a 'by-pass' connection between the two systems of mains to prevent any stagnation in the ends of the larger ones. The amount of water which passes here is small, and probably would always be in the direction from Prittlewell to Southend. If therefore the Southend water had been polluted, and so were the cause of the epidemic, a very much larger proportion of cases should have occurred over the area almost exclusively receiving water from the polluted well than in any other. This is not found to be the case.

The incidence of the disease in these different districts does not indicate the pollution of any of the waters at their source, and the generally wide spread nature of the epidemic, excludes the possibility of any local main infection being the cause. The subdivision of the district supplied by all three waters can however be carried further, *i.e.*

into two areas, one receiving water from the 'reservoir' and the other from the 'tower.' It must be remembered that the water flowing into the reservoir, is the overflow from the tower, and that therefore the waters are identical. Reference to the following table however shows that a much larger proportionate number of houses supplied by the 'reservoir' water have been invaded, than of houses supplied from the 'tower.'

	Houses attacked.	Per Cent.
Supplied by Tower	845	43
,, Reservoir	474	41

Assuming for a moment that the reservoir water was being polluted, then the epidemic should have been almost exclusively confined to the area supplied with it, *i.e.* to Lower Southend. But not only is that not the case, but the distribution of the disease in the reservoir district distinctly negatives such an assumption. Not a single case of Typhoid fever has been reported amongst the 50 houses connected with Scott's Villa sewer, yet they receive exactly the same water as the remainder of Lower Southend, in which 41 out of 424 houses (or nearly one in ten) have been attacked.

It may also here be remarked that the Water Co.'s reservoir main extends along the beach beyond the bounds of Southend, to supply 70 houses in the adjoining parish of Southchurch, in 4 of which cases of Typhoid have occurred. If the outbreak is due to the polluted water this complete immunity of a group of houses situated in the midst of the most infected area is almost inexplicable, but, as will be shown later, this immunity does admit of a simple explanation, and throws considerable light on the cause of the epidemic. The investigation so far gives no indications as to where the water supply was becoming polluted, assuming the water to be at fault. The turncock's book at the Waterworks Co.'s office was carefully examined, but there were no intermissions over any considerable area for months past, and the only intermission lasting over an hour on any of the district mains, which occurred prior to the general outbreak, was one on July 28th, necessitated by repairs to the main in Avenue Road. This branch only supplies some 30 houses, and at the point where the repairs were made there is no sewer or other source of pollution near.

Remembering Dr. Buchanan's demonstrations that, under certain circumstances, fluids and gases may be sucked through leaky water mains, even when running full and under pressure, I went carefully over the whole system of mains, and had them exposed in various places to verify the statements of Mr. Bilham, manager of the Water Company. The average depth of the water mains is 2ft. 6in., and there is only one point (in Scratton Road) where the depth greatly exceeds this. Here the main for a short distance lies at a depth of 8 feet, but there is no sewer near. The sewers and water mains cross in various places, but neither Mr. Bilham nor Mr. Dodd, the Surveyor, knew of an instance where the sewers were at the higher level. I did not discover the slightest defect in any of the mains. The great care which is taken in measuring the water raised at each of the pumping stations, and the system adopted for ascertaining the consumption over various areas, render it impossible for any serious defect to remain long undiscovered, and render it easy of localization.

The reservoir was also examined, as the bottom is far above the level of any sewer, any defect in it or on the sides could only result in a flow in a direction away from the reservoir. It is covered in and ventilated. The overflow pipe ends in a road gully near. At the bottom of the gully is an 18in. earthenware syphon cutting off all communication with

the drain leading to the sewer. I had this syphon and a portion of the drain uncovered, and found everything most satisfactory. To prevent any possibility of this syphon trap becoming unsealed during the summer, when little water overflows from the reservoir, a tap has been fixed on the embankment over a pipe leading to the syphon, and every Saturday afternoon Mr. Bilham himself flushes the syphon from this tap. There seems, therefore, no possibility of sewer air getting access to the reservoir, and being taken up by the water.

All my efforts to find a possibility of the water becoming polluted at any point have failed completely. I have come to the conclusion therefore that the water supply has had nothing whatever to do with the epidemic, and I am greatly strengthened in this opinion by a comparison of the course and character of this epidemic with others proved to have been caused by a polluted water supply.

The chief differences, which are well marked and important, shall be briefly indicated, and if arranged in tabular form are seen to be very striking. *Vide Table I.*

1. In epidemics due to polluted water a considerable proportion of those attacked are children under 15 years. Thus at Kidderminster 49 p.c., at Beverley 51 p.c., at Longton 65 p.c. were under this age. At Southend only 35 p.c. were children. As children are as prone to drink water in Southend as elsewhere such a discrepancy would be difficult to explain.

2. Females are probably greater water drinkers than males, hence in epidemics spread by water supplies a larger proportion of females is almost invariably attacked. In Kidderminster 60 p.c. were females, in Beverley 59 p.c., in Longton 60 p.c. but in Southend only 45 per cent. A marked difference, which also would require explanation on the water hypothesis.

3. The proportion of deaths to cases varies very considerably in such epidemics, but in Southend this death-rate is lower than in any of the other districts under consideration.

4. Where Typhoid fever is being spread through the agency of water, many instances occur in which two or more especially of the earlier cases occur in the same house at or about the same time. In Southend no such cases occurred. Where a second case occurred in a house, it was at such an interval as to lead one to infer that the second patient had been infected by the first. Where these cases of multiple infection are common, the number of cases of fever in a given number of houses will be higher than where such instances are rare. Thus at Kidderminster there were 161 cases to each 100 houses, at Beverley 185, at Longton 235, but at Southend only 125.

5. Another minor point also worthy of mention is that epidemics caused by polluted water occur at all periods of the year; the Southend epidemics invariably occur in Autumn.

Taken collectively these five strongly marked points of difference make the evidence conclusive, proving as far as it is possible to be proved that the Southend water supply was not the cause of the outbreak.

The Sewerage System. The probability of the epidemic being due to specifically infected sewer air now remains for consideration, and as I have got very complete data referring to the prevalence of Typhoid in Southend in previous years, I shall make use of them in elucidating the origin of the present epidemic. In the following table the number of houses invaded in the years 1885-8 inclusive, in 1889 and up to October 31st of the present year, upon each of the systems of sewers are recorded.

Sewer.	No. of houses on sewer system.	1885-8	Per Cent.	1889.	Per Cent.	1890.	Per Cent.
Prittlewell Tank	37	0	·0	0	·0	1	2·7
Scotts Villa	50	4	·8	12	24·	0	·0
Marine Parade	385	12	2·5	10	2·9	36	9·4
Pier Outfall	1322	26	2·2	24	1·9	76	5·75
Hamlet Valley	350	9	3·2	4	1·3	9	2·6
	2141	51	2·9	50	2·45	122	5·7

In calculating the percentage, due allowance has been made for the variation in the number of houses in occupation.

It will be observed that the proportion of houses invaded in this and previous years, on the different sewers, varies considerably, the variation being much greater than we found to obtain on the water main areas.

The immunity of the residents in Scott's Villas this year is easily explained. Many of the susceptible persons have been rendered immune by attacks in previous years, and no case of fever has been imported there up to the present to infect the sewer.

On the Prittlewell tank sewer with its 37 houses only one case is seen to have occurred since 1884, and that case almost certainly was imported from Southend.

This year, as in last, an excessive proportion of cases has occurred in houses on the Marine Parade east sewer, and many more have occurred on the Pier Outfall sewer than on the Hamlet Valley.

Scott's Villas. This group of houses lies at a lower level than any other in Southend. The end of the Outfall sewer on the beach is protected by a flap-valve, but at one of my visits the accumulation of faeces and paper at the mouth of the sewer was so great that the valve could not close for some inches. When originally made there were five man-holes left open for ventilation, these are now all closed, and three tall 6 x 4 in. ventilators have been erected. At ordinary high tide sewage accumulates in the sewer, and the displaced air passes through the ventilators, or in dry weather through imperfectly trapped road gullies. When the tides are a little higher than usual the yards of some of the houses are flooded with sewage. This is an exceedingly common occurrence. Given an imported case of Typhoid it is evident that we have every condition here necessary for an extension of the disease.

Send me
to see
only after
high tide
a very com-
mon

17
only twice in 1890

The Marine Parade East Sewer. Many of the houses on this sewer are at a low level, and when the tides are a little higher than usual the highway is always flooded with sewage. The outfall has a flap-valve on its extremity, but on the day above mentioned, when the Scott's Villa outfall was found in such a disgraceful condition, exactly the same existed here. Fæces and paper could have been collected by the bucketful. On this sewer system there were originally 49 man-hole ventilators, 25 of these have been closed and 14 shaft ventilators erected. That the ventilation is most inefficient is shown by the fact that when the tide is rising sewer air can frequently be heard to gurgle through the trap to the road gully, opposite the Sunflower Coffee Tavern. On November 7th I found about 200 feet of the road-way covered with sewage, unable to get away on account of the sewer being tide-locked.

Most of the sewers are 9in. glazed pipes, but in York Road a 9in sewer receives two 12in. branches. *Laid by private owner despite protests.*

The effluvium nuisance from these sewer outfalls is often very serious. I saw a vessel which had just been removed because the odour from the sewers was so bad that the men objected to go on with the unloading until it had been taken further from the outfalls. A man who has resided near for 17 years stated that with a S.W. wind and a hot sun the smell 'sometimes nearly chokes you.' He had frequently seen paper and fæces floating among the bathing machines.

The Pier Outfall Sewers. All Prittlewell and Porters Town, and the greater portion of Southend are connected with the Pier outfall. The small sewer system was adopted in Southend when these sewers were laid in 1870, and possibly at that time met the requirements of the town. Since then Prittlewell has been sewered, and Porters Town and other districts which have developed enormously, have been sewered and connected with the Pier outfall. The result now is that the new sewer from Victoria Avenue, which has a diameter of 18in., is connected by a short length of 12in. sewer with a 15in. sewer in Southchurch Road. The Royal Terrace sewer, diameter 15in. receives tributaries from Scratton Road, Cambridge Terrace, Alexandra Road, and Clifton Parade, and opposite the Royal Hotel joins the High Street sewer, also of 15in. diameter. This also receives tributaries from all the smaller off-streets, from London Road, Queen's Road, Park Street, Princes and other Streets. From the point of junction a short length of 2ft. sewer is laid to the Pier Hotel, and there receives the 15in. Prittlewell and Porters Town sewer, and at a little lower level the 12in. sewer from Marine Avenue West. The whole of these empty into the 15in. outfall sewer, which extends under the beach for 4000 feet, and has a very slight fall. This outfall sewer being inadequate for the purpose, and certain houses in the town being periodically flooded, three storm overflows have been laid from the man-hole at the junction of Grove Terrace and Grove Road and High Street, to the beach, emptying at one common outfall under the head of the New Pier. Many complaints were made to me as to the offensive matter passed through here on to the beach, in the centre of the Promenade, during heavy rainfalls, and also of the exceedingly offensive gases which escape and become diffused over the covered platform from which the electric tram starts. This is a place much frequented by visitors, and it is certainly not improbable that a sojourn here, breathing the specifically polluted sewer air, may have been the cause of many cases of Typhoid fever, as has been suggested. These storm overflows are not ventilated, and the outfall had a flap valve at its extremity.

This was done 20 years ago

Besides the construction of these outfalls, attempts have been made to further relieve the High Street sewer by diverting the storm water from a few of the road gullies. *sewage diverted into Pittewell sewer.*

When first constructed there were 154 man-hole ventilators on this system. Of these no less than 111 have been closed. Yet to replace these only 45 shaft ventilators have been erected. The ventilation is woefully deficient, and to increase the evil only a small proportion of the house drains are trapped where they enter the sewer. In these small inadequately ventilated sewers, the entrance of a certain volume of water during a rainfall, or when the tide is rising, causes a much greater air-pressure than in a larger or better ventilated system. I am decidedly of opinion that no water-seal can stand the pressure which must obtain from time to time in sewers of this character. The following quotations from a report by Dr. Buchanan on an outbreak of Typhoid fever at Croydon apply with even greater force to Southend. "Where sewers are small and ill ventilated they constitute perfectly sufficient means for the rapid distribution of fever infection, and places having such sewers may show as smart outbursts of fever as are witnessed when conveyance through water or milk is in question."

The Hamlet Valley Sewer. This sewer is more modern, having been laid in 1879-80, and is of adequate dimensions for the number of houses connected. The ventilation however is inadequate. When first laid there were 31 man-hole ventilators, but 18 of these have been closed and 14 shaft ventilators erected in their place.

Complaints of "smells" from road gullies and from sewer gratings were frequently made during my visitations, and many of the patients attribute the disease to a whiff of particularly offensive sewer air. Unfortunately such complaints have not heretofore been regarded so much in the light of proofs that the sewers required more adequate ventilation, but as complaints of nuisances which could be remedied easily and effectually by closing a man-hole.

There are no valves, I understand, on any of the systems of sewers to prevent sewer gases being forced from the lower to the higher levels.

Taking into consideration not only the residents, but also the large number of visitors in the summer season, I am decidedly of opinion that these main sewers are inadequate for the requirements of the town, and are responsible in a great measure for the prevalence of Typhoid epidemics. Not only however are the sewers defective in calibre, but it is acknowledged that they are defective in other respects. In all the older portions the joints are of clay, and probably now not even the clay remains, so that the porous subsoil has become saturated with sewer air, which doubtless is drawn into the basements of large numbers of houses. The condition of the sewers is well shown by the results of some experiments made in Dec., 1887, by Mr. BILHAM, when he had reason to suspect a leakage from a water main. Between 11 p.m. and 5 a.m. he found 1300 gallons per hour of water passing to one outfall, and 700 gallons to another, an amount far exceeding that of the water passing from the works at the time. The amount flowing from the two other outfalls was not determined. Evidently therefore a considerable volume of water per hour was passing from the subsoil into the sewers, and probably through the defective joints.

numerous land pumps are said to discharge into the sewers.

House Drainage. As Mr. SHIRLEY MURPHY has so recently reported on the sanitary condition of the town, it is unnecessary to describe this more fully than is required for the object in view. I shall confine myself therefore to enumerating the defects found in my visits to infected houses.

Of the 122 houses in Southend in which cases of Typhoid have been reported this year, 40 only had water-closets inside. In 23 of these the soil pipe was not ventilated, and in 11 there were more or less serious defects in the ventilators, so that only 12 out of the 40 could be said to be satisfactory in this respect. In 6 houses the old pan and container closet was found. In 9 houses the waste-pipe from the sink passed directly into the drains. Out of 65 houses in which the condition was either known or could be ascertained, in 32 the stack-pipes were directly connected with the sewers. From very many of these sewer gas was escaping at the joints, and often in dangerous proximity to windows or doors. In 4 cases the drains were blocked either at or just before the outbreak of the fever. In only 8 cases were the drains known to be trapped before joining the sewers, in all the others the Inspector informed me that he felt sure they were directly connected. *Surveyor says 15 - houses built before existing byelaws.*

In one house in which two cases of fever have originated this year, there was a fatal case at the end of last year. When the drain was examined it was found blocked with soil, and the joints being clay the sewage matter had impregnated the ground around. For a considerable distance if there was any fall it was in the wrong direction. This is one of a pair of recently erected villas. Three families have occupied this house within 12 months, and fever cases have occurred in two. The house was not disinfected until after the second case. In another and larger house there was an old pan closet in the centre of the landing of the first floor. All the inmates who slept on this landing contracted Typhoid. No other members of the household were affected.

As to the condition of the drains, traps, &c., I will let the two cases which I carefully examined speak for themselves. The Surveyor having placed a number of men at my disposal, a group of cottages ^{2 or 3} was selected and the drain dug down upon. The pipe first exposed was found to be broken, and a half-brick had been stuffed into the hole to keep out the earth. The ground under the next length had given way to such an extent that a child could have crawled under the pipe. The joints were of clay. When smoke was blown into the drain it issued freely from the ground at numerous places along the course of the drain. It passed into the kitchen of the first house, and through a defective trap into the yard of the second. In fact it found such ready egress that it could not be forced beyond the second cottage.

At an adjoining block the drain was exposed. The joints were said to be of cement, but it was easily removed with a pocket knife. When smoke was driven in here it found such a ready outlet round the base of the first closet pan that it could not be driven beyond. Numerous cases of fever have occurred in these blocks. These defects in trapped drains would be serious enough, but the danger is fearfully enhanced where the drains are connected with sewers which are inadequately ventilated, and of such small calibre that the gaseous emanations are most concentrated and are subject to great changes in pressure.

Has not described sound drain he found to exist, when 3 cases of Typhoid occurred. 2 drain diam. from 2 in.

Houses in which other cases have occurred in previous years. Out of the 122 houses investigated, cases of fever had occurred in 15 at least once before since 1886, *i. e.* in 12.5 per cent. Out of 36 houses on the Marine Parade outfall, no less than 8, or 22.2 per cent. had been previously invaded. Of the 49 houses in which Fever was notified last year, in 2, cases had occurred in 1888, and in 12, cases have occurred this year. Taking Southend as a whole only 5.7 per cent. of the houses have been invaded this year, yet 25 per cent. of the houses in which fever occurred last year have been affected again this year. Infection by milk or water will not explain such facts as these, it is the defects in the houses themselves, and in the drains and sewers, that we must look to for the explanation.

These are the factors which each Autumn favour the development of Typhoid Fever, and the unusual prevalence of the fever in the parishes around Southend, which are neither supplied by the same water, nor connected with the same sewers, justifies the conclusion that the climatological conditions this year have been such as to accentuate the danger arising from these pre-existing and pre-disposing causes.

Neither in the mode of onset, nor in the way in which the disease has spread, nor in the way in which particular localities have been affected, is there anything to negative this supposition. On the contrary it appears to me to explain satisfactorily all the facts in connection with the outbreak which have come to my knowledge.

In my opinion, therefore, the causes of the outbreak may be briefly stated as follows:—

- 1.—Climatological conditions especially favourable for the development and spread of the disease*
- 2.—The introduction of cases from without, and the appearance of sporadic cases just at that season when everything was ripe for an outbreak.
- 3.—The small tide-locked, imperfectly ventilated sewers, breathing out at every rise of the tide specifically polluted sewer air containing the poison in a highly concentrated condition.
- 4.—Flooding of yards, roads and beach with specifically infected sewage.
- 5.—Direct communication of defective drains with sewers, bringing the sewer air into immediate proximity to the houses.
- 6.—The inadequate flushing of the sewers during a very dry September, and the evaporation of the water in the road gully traps, causing them to become unsealed.
- 7.—The absence of any arrangement for isolating fever patients, so as to prevent infection of the sewers, and the spread of the disease by personal infection.

* Vide diagram of Rainfall and No. of cases each month. Probably the deficient rainfall during September was an important factor.

*the
caution for
tection and to
taken -*

8.—Defects in sanitary administration. Stools permitted to be cast into the sewers without adequate disinfection. Infected drains, closets, etc., not systematically flushed and disinfected. No systematic disinfection of infected houses.

Recommendations. I should strongly urge upon the Local Sanitary Authority the desirability of carrying out the following recommendations with the least possible delay.

1.—To consult a skilled sewer engineer as to the best method of securing the efficient drainage of the Town, with special regard to the ventilation and flushing of the sewers, the prevention of the periodical flooding of certain districts, and the discharge of the sewage from those districts in such a way as to prevent any possibility of any portion of it being cast back upon the beach.

2.—To provide a suitable Hospital for the isolation and treatment of Infectious diseases, and a suitable appliance for disinfecting bedding, clothing, etc.

3.—House drains which are suspected should be tested, and if found to be defective should be reconstructed. All house drains should be disconnected from the sewers. All soil pipes should be properly ventilated. The numerous water closets which at present depend upon hand flushing should have cisterns put in.

4.—More careful supervision should be maintained over buildings in the course of erection. It is impossible for the Town Surveyor to discharge his other duties satisfactorily and at the same time act as Building Inspector. A Building Inspector should be appointed to see that none of the bye-laws are infringed.

5.—To appoint a Medical Officer of Health, at an adequate salary, to give his whole time to the discharge of his duties.

JOHN C. THRESH.

Nov. 21, 1890.

Table 1.
 COMPARISON OF TYPHOID FEVER EPIDEMICS CAUSED BY POLLUTED WATER WITH THE SOUTHEND
 EPIDEMIC OF 1890,

Name of Town.	Prior to outbreak.	Reporter.	Population.	No. of Cases investigated.	No. of houses attacked.	No. of cases to 100 houses	Death rate per 100 cases	No. of females per 100 cases.	No. of children under 5 in 100 cases.
KIDDERMINSTER	... Aug., Sept. Oct.	Dr. Parsons.	25,500	1112	690	161	7.5	60	49
BEVERLEY	... ...	Dr. Page.	12,000	231	125	185	5.2	59	51
LONGTON	... ...	Mr. Spear.	35,000	155	66	235	19.	61	65
SOUTHEND	... ...	Dr. Thresh.	13,000	156	125	3.85	45	35	

Copy of two Analytical Reports by Dr. TIDY, London Hospital, London.

The results are stated in grains per imperial gallon of 70,000 grains, the Organic Carbon and Nitrogen being stated in parts per 100,000.

DESCRIPTION.	Total solid matter.	Ammo-nia.	Nitrogen in Nitrates and Nitrites.	Nitric Acid.	Oxygen required to oxidise organic matter.	ORGANIC.		Lime. Ca. O.	Magnesia Mg. O.	Sulphuric Acid. SO ₃ .	Chlorine mon Salt.	HARDNESS.		REMARKS.		
						Carbon.	Nitrogen					Before Boiling.	After Boiling.			
1. Sample taken at Southend, March 2nd, 1880.	64.25	.001			.09 = .405			.061	.020	1.47	.504	4.47	22.75 = 37.28	1.6	.4	Silica 1.7
2. Sample taken at Prittlewell, Feb. 16th, 1888.	67.04	.009			.125 = .562			.024	.020	1.53	trace.	8.32	27.31 = 44.8	2.18	.12	Clear, colourless in bulk. Silica .86

Signed C. MEYMOOT TIDY, M.B.,

Professor of Chemistry, etc.

Copy of an Analysis of a sample of Water from the Southend Town supply, made by

Dr. LANE NOTTER, at the Army Medical School, Netley.

Drawn July 11th, 1890.

Examined July 18th, 1890.

	Parts per 100,000.	Parts per 100,000.
Volatile Matter	2.0000	·0440
Chlorine	...	none.
Calcium Carbonate	...	none.
Fixed Hard Salts	...	·1954
Sulphuric Acid (S O_4^4)	...	none.
Alkaline Carbonates	59.7334	·0441
Fixed Hard Salts, Silica, etc.	...	traces
Sodium and other metals combined with Cl. S O_4 not included	2.5	...
Total	94.500	3.0

Microscopic Examination.—A little Mineral grit, a little Vegetable fibre, and a few crystals of Carbonate of Lime. There is no trace of animal or vegetable life.

Report.—This is a very soft water, and contains an extremely small amount of organic impurity. The Chlorine is large, and is probably derived from the stratum from which the water is taken. The water is quite fit for drinking purposes.

Signed H. LANE NOTTER, Professor of Hygiene.

Analyses of Waters collected by Dr. THRESH at Southend on October 11th, 1890.

Taken direct to Laboratory and examined on 12th and 13th.

RESULTS IN GRAINS PER GALLON.

SOURCE OF SAMPLE.	Physical Characters.	Total Solids.	Effect of Ignition.	Phos- phates.	Nitric Nitrogen.	Chlorine	Alkali- nity.	Hardness	Lead and Iron.	RESULTS IN PARTS PER MILLION.				
										Ammonia	Nitrogen	Organic	Nitrous	Oxygen used in 3 hours.	Oxygen in Solution.
1. Cottage in Prittle- well	Faintly turbid.	66.	nil.	·065	19·6	18·2	3°	3°	·01	·015	none	·50	not determined.	
2. Cottage in New- lands Road	Clear and Colourless.	65.	,,	·055	22·8	18·5	3°	3°	,,	·25	·01	,,	·34	,,
3. House in Cam- bridge Terrace	,,	64.	,,	·05	23·1	18·5	3°	3°	,,	·08	·01	,,	·31	·34

Microscopic examination revealed no trace of animal or vegetable life. No. 1 contained a little suspended mineral matter, which was calcareous and ferruginous. I have compared these analyses amongst themselves, and with others from the same stratum, and find not the slightest indications of pollution.

JOHN C. THRESH, D. Sc. (Lond.), B.M., etc.

Medical Officer of Health.

Analyses of Samples of Water taken by Dr. THRESH from the various Pumping Stations
supplying Southend-on-Sea.

Samples taken October 15th, 1890.

Analysed October 16th—18th, 1890.

RESULTS IN GRAINS PER GALLON.

SOURCE.	Physical Characters.	Total Solids.	Effect of Ignition.	Phos- phates.	Nitric Nitrogen.	Chlorine	Alkali- inity.	Hardness	Lead and Iron.	RESULTS IN PARTS PER MILLION.			
										Ammonia	Organic Ammonia	Nitrous Ammonia	Oxygen used in 3 hours.
1. Overflow from Main at Eastwood Well	Clear and Colourless	66.	nil,	none.	.08	19.3	19.7	2.5	none.	.66	.02	.00	.17
2. Pumping Main at Prittlewell Well	,	73.	nil.	none.	.07	23.5	18.7	2.5	none.	.66	.015	.00	.21
3. Pumping Main at Southend Well ...	Faintly turbid	66.5	nil.	none.	.05	23.2	18.5	3.	none.	.48	.01	.09	.20
													3.0 2.3 after keeping 12 days

Microscopical Examination. No vegetable or animal life. No. 3 contained a little calcareous and siliceous matter in suspension. No signs of pollution.

JOHN C. THRESH, D. Sc. (Lond.), M.B., etc.,

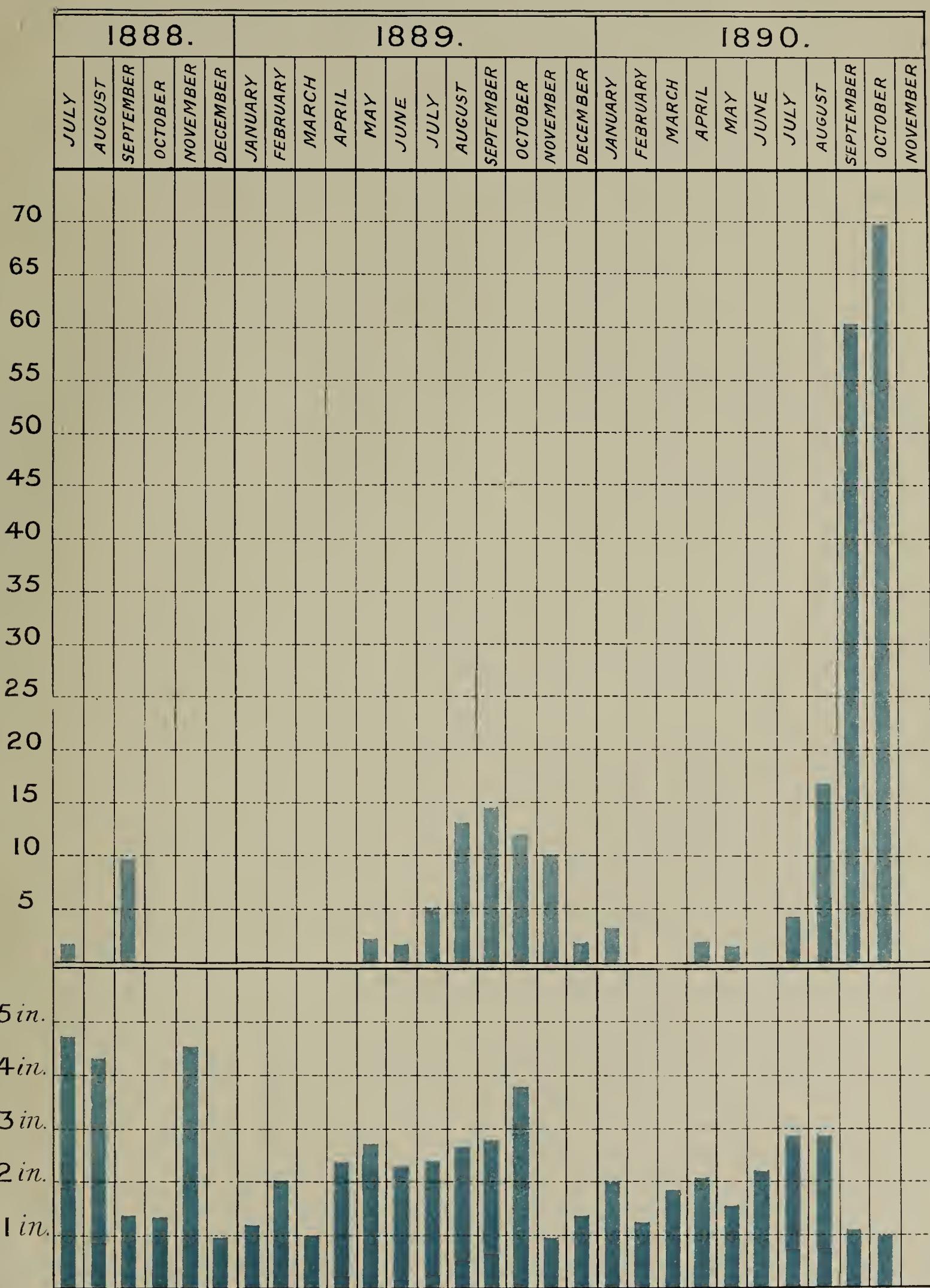
Medical Officer of Health.





BLUE	=	[REDACTED]	Pier Outfall District.
RED	=	[REDACTED]	Hamlet Valley Outfall District.
GREEN	=	[REDACTED]	Scott's Villas Outfall District.
SEPIA	=	[REDACTED]	North Street Tank District.
YELLOW	=	[REDACTED]	Marine Parade Outfall District.

TYPHOID CASES NOTIFIED EACH MONTH
 JULY, 1888, TO NOV. 1890.



Southend Local Board.

REMARKS BY THE SANITARY COMMITTEE
ON
DR. THRESH'S REPORT.

MORTALITY STATISTICS FOR 1890.

[Calculated on a population, as estimated by Dr. Thresh, of 12,116.]

Total Zymotic death rate	-	-	2.3
Death rate from all causes	-	-	15.6

Assuming, with Dr. Thresh, an additional summer population of 10,000 for three months, and leaving out of account the early and late visitors, the average population for the year would be 14,616, and the death rate calculated on this basis would be

Total Zymotic death rate	-	-	1.9
From all causes	-	-	12.9

SOUTHEND LOCAL BOARD.

REMARKS BY THE SANITARY COMMITTEE ON DR. THRESH'S REPORT.

Whilst Dr. Thresh's Report was going through the Press, numerous errors of fact, principally historical and descriptive and not calculated to affect his conclusions, were noticed and pointed out to him, and most of these were corrected by him, though a few were allowed to remain. The Local Board, however, refrained from remarking on or proffering evidence respecting any part of his report which might be considered to reflect on their conduct or proceedings, or on the state of their district. Since the report has been printed it has been carefully considered by the Sanitary Committee of the Local Board, and several points have been noticed on which they think it would have been fair and just to the Local Board and to the town, either that an obviously wrong inference, probably not intended, should be corrected, or ready explanations of true, though partial and injurious, statements should be furnished. Dr. Thresh's attention has been drawn to these, but it devolves on the Local Board to publish the following statement, in which some of the more important of them are noticed and what the Local Board think may fairly be considered the other side has been attempted to be set out. There still remain, however, other points which have not escaped notice, but which, as to part, will be readily apparent to the critical reader, and as to the remainder it would be tedious and of doubtful utility to indicate.

With the recommendations of Dr. Thresh as a whole the Local Board cordially agree. He is doubtless aware how far the law will enable them to be acted on, and so far the Board hope at once to proceed, while they will also endeavour by advice and persuasion to accomplish the rest.

Prefatory Letter.

The proposed new sewer referred to in Dr. Thresh's prefatory letter as an "intercepting sewer" should hardly be so described. It is in fact an entirely new system designed for the sewerage of a new part of the district, though it will also serve part of that already built upon, and will intercept a part of the sewage now going to the existing Pier and Marine Parade (East) outfalls, and thus to a great extent, if not entirely, prevent the flooding of the lower part of the town by excluding the high level drainage from the low level. The whole scheme has been reported on approvingly by Mr. Mansergh, C.E.

Page 4, par. 2.

With reference to the statement that "Southend has no Hospital for Infectious Diseases," it should be observed that by permission of the Rochford Rural Sanitary Authority, the Local Board are entitled to send, and do send, cases to the Hospital at Rochford. In addition, extra temporary hospital accommodation was provided within four days of its necessity being communicated to the Sanitary Committee, and adequate provision has been made for all cases which have been recommended for removal.

Par. 3.

"A large proportion are hand flushed." The actual proportion is about 250 closets out of considerably over 2000. The small cisterns referred to in this paragraph are presumably water waste preventers, the houses being in all cases supplied independently.

Page 5, par. 4.

Scott's Villas Sewer and Marine Parade (East) Sewer in addition to having flap-valves at the outer extremities of their outfalls, have also flap valves in the manholes where they pass through the sea wall.

Page 6, par. last
but one.

"The only arrangements for flushing," &c. In addition to the flushing tanks mentioned in this paragraph, there is a flushing tank of 1800 gallons capacity at the summit of the Victoria Avenue sewer. All other sewers requiring flushing are flushed by specially constructed water vans, one of which is of 400 gallons capacity, and by this means alone the following quantities of water were used in the month of September:—

		Gallons.
Flushing	Marine Parade Sewer	23,200
Do.	other Sewers	17,200
Do.	and filling Gullies	44,560
		<hr/>
	Total for September	84,960
		<hr/>

Last paragraph.

It might be inferred from this paragraph that the Local Board have failed in their duty to remove accumulations of shells from oyster and fish shops, whereas these are trade refuse and not removable by the Local Board, except under the nuisance removal clauses and under which the speedy removal of the refuse in question by the occupiers was obtained throughout the summer.

Page 7, par. last
but one.

"Typhoid Fever is more than twice as fatal in Southend than in Essex as a whole." It is now known that this sentence does not accurately express Dr. Thresh's meaning, and that instead of the word "fatal" the word "prevalent" would have been more in accordance with his opinion and intentions. Assuming that the Typhoid throughout Essex is of a similar type, and that the populations upon which the Zymotic death rate is calculated are adequately estimated, the statement as above amended might be considered well founded. It should be noticed, however, that the calculation of the Zymotic death rate is based on an estimated population in Southend of 11,250. This is believed to be a low estimate even for April (the census month), but when it is remembered that Typhoid has only visited Southend in the early Autumn, when the population, according to Dr. Thresh's estimate, is 22,000, and at which period there is no similar increase of population but rather a decrease throughout the remainder of the county, the comparison so unfavorable to Southend is materially altered even if its unfavorable aspect does not entirely vanish. The table on page 10 of Dr. Thresh's report shows that as regards the number of cases, Southend suffered much less than the contiguous parts of the County, whilst it is asserted by the Medical Men practising in the town, and the statement is confirmed by table 1 at the end of Dr. Thresh's report, that the cases occurring in Southend were of a peculiarly non-fatal type.

Page 8, par. 1, line 4

"In May and June four cases were reported." There was no notification of Infectious disease in Southend, until 1st January, 1890, and the same remark will apply to a similar statement on page 20, paragraph 1.

Page 14.

Several statements on page 14 indicate the existence in Dr. Thresh's mind of a suspicion of the reservoir water, viz: line 4, the table following line 5, line 8, and line 21. The water having been already found pure at its sources, and suspicion being thus aroused respecting it after passing the reservoir, it would have been much more satisfactory had the suspicion been effectually disposed of by the test of an analysis of a sample from the reservoir. However the Local Board at once suggested to the Water Company the desirability of emptying and cleansing their reservoir and are informed that this was promptly done.

Page 16, last par.

It is believed that Dr. Thresh's reference to the "imperfectly trapped road gullies" was intended to read "imperfectly sealed road gullies." He does not allege the finding of any imperfect trap, neither does he allege having found any imperfectly sealed road gully, nor to having received any evidence of any other person having found one. The Local Board believe, that from the precautions taken, not one could have existed, and that there is no ground for the suggestion contained in the remark in the report. The occasional flooding of yards is admitted, but only at unusually high spring tides. It is by no means "common." Steps have already been taken to remedy this, and it is believed that the new sewer about to be laid will complete the remedy.

Page 17, par. 1.

The flooding of the road referred to in this paragraph, happened twice in the year 1890, viz: on the two occasions when there were extraordinary high spring tides. See last remark as to the remedy.

Par 2.

The 12 inch branch sewers, referred to in this paragraph, were laid by the owner of a private building estate against the futile protests of the Local Board who declined to incur the expense of unnecessarily enlarging their sewer. The correctness of their view has been proved by the fact that one of these two branch sewers drains one house only, and the other drains five houses.

Par. 4, line 6

"The result now is" &c. It does not appear to the Local Board that this is by any means the result of what precedes. The Victoria Avenue Sewer is to form part of the large new system referred to in Dr. Thresh's prefatory letter, but was laid down in advance of that system concurrently with the making of Victoria Avenue. At present only the Great Eastern Railway Station drains into it, and the short 12 inch connection with the Prittlewell Sewer though ample for the present, is temporary only, pending the completion of the system referred to.

Line 16.

"This outfall sewer being inadequate and certain houses being periodically flooded." The Local Board believe that there is no foundation for either of these statements. The outfall sewer has never been found inadequate except for storm water, for which it was not constructed, and they do not know a single house in the town which is periodically flooded.

Page 18, par. 1.

Dr. Thresh appears to have been misinformed as to the steps taken to relieve the High Street Sewer. The road gullies which now discharge into a separate drain have so discharged for 20 years, ever since the sewer in the same street was first constructed. The relief has been obtained by diverting some of the sewage into the Prittlewell Sewer running parallel with it.

Par. 6. "These main sewers are inadequate." On this point, probably, the Local Board will adopt Dr. Thresh's recommendation to consult a skilled Sewer Engineer. Mr. Shirley Murphy's opinion in March, 1888, was "The sewers appear to be well constructed and "speaking generally, in capacity, are equal to the present requirement of the district."

Line 5. "It is acknowledged that they (the sewers) are defective in other respects." This statement would appear to imply that the Local Board, who alone have the power to correct defects, or their responsible Officers, admit that the sewers are defective, but this is contrary to the fact, and they are believed by the Local Board to be both adequate and in good condition.

The experiments referred to later in the same paragraph are believed to be incapable of verification, but even were they so they are hardly of value for the purpose for which they are used, as the whole excess of water found (amounting, it is believed, to about 200 gallons per hour) can be accounted for by the numerous land springs, &c., which now discharge into the sewers at various points.

Page 19, par. 2. "In only eight cases were the drains known to be trapped before joining the sewers." Doubtless the majority of cases of typhoid have occurred in houses built more than 10 years ago, *i.e.* before the existing bye-laws, requiring the trapping of drains, came into force. But even here the statement is below what is believed to be the fact, as the Surveyor alone can specify 15 of the houses affected where the drains are known to be trapped.

Par. 3. The fatal case occurring in this house at the end of 1889 did not come to the knowledge of the Board, or the Sanitary Committee, or the Inspector of Nuisances till the two concurrent cases originating there this year were notified. The house was disinfected as soon as possible after the recovery of these last cases, and there has been no illness there since.

In the case of the house referred to as having an old pan-closet, the inference to be drawn from the paragraph is that this was the cause of illness; but this is known not to be the fact; nor is it correct that all the inmates who slept on the same landing contracted typhoid.

Par. 4 & 5. The last two paragraphs on this page hardly give a full account of the examinations carried out by Dr. Thresh, and therefore the impression conveyed can hardly be accepted as a just one. The group of cottages referred to in the first of the two paragraphs consists of a row of 12, built about 20 years ago, and in which there had been no infectious illness until 1890. The defects disclosed are correctly stated. It should be added, however, that in this row of 12 cottages only one case of typhoid occurred. The drain described as exposed at the adjoining block was a branch drain laid for one water-closet only, and had no separate ventilator. It is hardly remarkable, therefore, that the smoke could not be driven beyond the first closet pan, as there was no "beyond." In the house to which this closet belongs one case of typhoid occurred. Dr. Thresh also, on the same day, examined a drain close by that last referred to, and which serves three closets besides the sink wastes from five cottages. This drain was found perfect, as no smoke could be forced through anywhere except the drain ventilator at the far end, and when this was

stopped no smoke could be perceived anywhere. Out of five cottages served by this perfect drain three were affected with typhoid. It should be added that these last two drains, with others near by, are together disconnected from the main sewer by an efficient trap.

Page 20.

"CAUSES OF THE OUTBREAK," No. 6.—(See the foregoing remarks on page 6 of Dr. Thresh's Report) The Local Board have failed to learn of a single case of a gully trap having been found unsealed.

No. 8.—With regard to disinfection of stools, every house affected has been visited by the Medical Officer of Health and Inspector of Nuisances. Disinfectants have been supplied, and instructions for disinfecting given in all cases, and sometimes the occupants have been shown how to use the disinfectants. With regard to the disinfection of houses, 37 have been disinfected by the Inspector of Nuisances, and 13 others have been done in his presence. Many others have been done by the owners or occupiers without superintendence. A few cases remain in which disinfection has still to be carried out, besides others in which the patients are still not recovered.

Recommendations.

With regard to these, the following resolutions have recently been passed by the Local Board.

1.—"In order to prevent the possibility of sewage being cast back upon the beach, it is desirable to remove the sewer outlets near the Castle Inn, and that it be an instruction to the Special Sewerage Committee to consider and submit a scheme for such removal in an early report, so that the work may be carried out by June, at latest."

2.—"It is desirable that the Ventilation of existing sewers be greatly increased; therefore, if Keeling's Patent Sewer Ventilator ordered to be erected at the junction of Grove Terrace be found by the Sanitary Committee to work satisfactorily, that six additional Ventilators be forthwith obtained and erected under the supervision of the Roads Committee, as follows:—Summit of Marine Parade Sewers; Junction of Victoria Avenue with London Road; ditto West Street and Victoria Avenue; ditto Park Street and London Road; ditto Wilson Road and Scrutton Road and by the Cricketers Inn."

3.—"That it be an instruction to the Sanitary Committee to prepare a list of all houses in which an infectious disease has appeared in the years 1885—1890; that in such list be placed blocks of houses erected at the same time by same builder, even though the disease has made its appearance in one house only; that all such houses be carefully inspected and the drains tested, and that the Committee be empowered to issue (subject to the approval of the Board) certificates of sanitary sufficiency to each owner who, before Lady Day, 1891, complies in a workmanlike manner with the requirements of the Committee."

4.—"That in order to provide for more frequent inspection of new buildings, and with a view to strictly enforcing the Bye-laws, it is desirable to appoint a Building Inspector, who shall be under the direction of the Surveyor. That it be an instruction to the Roads Committee to bring up a recommendation as to salary, &c., at the next Board meeting, with a view to an immediate appointment."

In addition to this the appointment of a Medical Officer of Health at an adequate salary has been resolved on, and the proposals for the purpose are now before the Local Government Board, one of the terms being that the officer appointed shall give his whole time to his duties, though it is very doubtful whether the Local Government Board will give their consent to this.

